CLAIMS

1. A medium access control system in a wireless network, comprising:

(i) an access point equipped with an SDMA compatible multi-beam antenna and a plurality of transceivers that can respectively be simultaneously connected to different antenna beams; and

(ii) one or more stations scattered in reception space of a wireless LAN.

2. The system according to claim 1, further including a timing structure comprising:

(i) a periodically transmitted beacon frame that reports existence of a wireless network and provides a timing reference to each station on said network;

(ii) a supervised access mode that is a period in which an access point effectively improves network throughput by controlling access to a wireless channel and adjusting transmission with users so that antenna characteristics are utilized and a plurality of simultaneous transmissions can be implemented on a same channel;

(iii) an unsupervised access mode that is a period in which an access point antenna is configured in an omni-directional pattern, and each station accesses a channel freely so as to be able to perform transmission

using conventional carrier sensing technology; and

(iv) signaling whereby an access point starts or terminates a supervised or unsupervised access period.

3. The system according to claim 1, further including a protocol stack comprising:

(i) a medium access control layer that defines an access rule whereby a plurality of wireless stations access a common medium;

(ii) a physical layer that performs actual data transmission and reception on a wireless channel; and

(iii) a management entity that manages and adjusts operation of said medium access control layer and said physical layer in order to improve overall wireless network throughput.

4. The system according to claim 3, wherein said medium access control layer comprises:

(i) a contention based access mechanism whereby a carrier sensing mechanism is used and stations compete for a transmission medium based on one set of rules;

(ii) a polling based channel access mechanism whereby an access point can satisfy a band request of a specific station while maintaining a service quality level specified beforehand by that station; and

(iii) a beam access coordinator that implements high-throughput by adjusting data transfer between

antennas and an access point and utilizing a function of a multi-beam antenna using said contention based and said polling based access mechanisms.

5. The system according to claim 2, wherein said beacon frame described is broadcast by an access point, and has a function that reports existence of a WLAN and provides a timing reference to stations scattered on a network, and comprises:

(i) an identifier unique to said wireless network whereby each station can uniquely and explicitly identify an access point and therefore a specific network;

(ii) wireless network function and protocol related information specially defined by implementation of an access point;

(iii) information describing a used frequency of a beacon broadcast by an access point on a wireless network; and

(iv) a period in which a wireless network operates in supervised access mode, and whereby a conventional station does not execute association or transmission in that superframe period, as a result of which effects on wireless network throughput due to such transmissions/collisions are minimized.

6. The system according to claim 5, wherein said wireless network function and protocol related information

comprises:

(i) a protocol reference number that enables a station's medium access control protocol type to be confirmed;

(ii) antenna type and pattern;

(iii) antenna switching/operating functions; and

(iv) station direction finding/positioning functions.

7. The system according to claim 1, wherein said station, when wishing to associate with a specific wireless network, transmits an Association Request frame that comprises information elements described in following (i), (iv), and (v), and further arbitrarily comprises information elements described in (ii) and (iii) according to a network configuration and station function, and reduces signaling overhead:

(i) a wireless network identifier received in a beacon frame for notifying an access point that a station wishes to associate with a WLAN;

(ii) a group identifier of a beam group that includes a station in its range and for which that station desires association, determined by that station by detecting presence or absence of a Beam Start Beacon and Beam End Beacon;

(iii) a beam identifier of a specific beam that includes a station in its range and for which that station

desires association, determined by that station by detecting presence or absence of a Beam Start Beacon and Beam End Beacon;

(iv) an address of a station itself enabling unique identification by an access point in a next communication; and

(v) information relating to characteristics and functions of a protocol implemented by a station, that determines a possibility or otherwise of association with an access point, and determines a method of providing the best service to that station when association is accepted.

8. The system according to claim 7, wherein said access point, in response to said Association Request frame, transmits an Association Response frame request that accepts or denies a request of each station, and comprises information elements described in following (i), (iv), and (v), and further comprises arbitrarily information elements described in (ii) and (iii) according to a network configuration, said access point and station functions, and a structure of a transmitted Association Request:

(i) a wireless network identifier for acknowledging and responding to an Association Request created by a station;

(ii) a group identifier of a beam group used by an access point for communication with that station;

(iii) a beam identifier of a beam used by an access point for communication with that station;

(iv) an address of a station itself that is an Association Response transmission destination; and

(v) information relating to request status (that is, success or failure) and characteristics and functions supported by an access point.

9. The system according to claim 1, wherein said access point transmits an Acquisition Request that requests transmission of a predetermined training sequence to a station for a certain period, and identifies a spatial location of that station with respect to itself using that transmission, said Acquisition Request comprising:

(i) an address of a station that makes an Acquisition Request;

(ii) an address of a station that is an Acquisition Request transmission destination; and

(iii) transmission period or length of a training sequence requested in order to transmit an address to a specified station.

10. The system according to claim 1, wherein said access point transmits to a station a group ID assignment (Group-ID Assign) frame that performs assignment to a specific beam group for further transmit/receive operations, said Group-ID Assign frame comprising:

(i) an access point address/WLAN ID;

(ii) an address of a station that is a transmission destination of said Group-ID Assign frame;

(iii) a group ID determined by an access point and assigned to a station whose address was specified; and

(iv) a beam identifier of a beam used by an access point in a next communication with a station whose address was specified.

11. The system according to claim 1, wherein said access point broadcasts to each station of a specific beam group a Beam Start Beacon frame that indicates a start of operation to users of that beam group, said Beam Start Beacon frame comprising:

(i) an access point address/WLAN ID enabling identification of a transmission source for each station;

(ii) information relating to wireless network functions and protocol;

(iii) a group ID of said beam;

(iv) a beam ID of said beam;

(v) a period in which said group is active -that is, a period in which an access point performs transmission/reception with users of said group before switching to a different pattern in order to handle users of another group;

(vi) a frequency for transmitting a Beam Start Beacon that makes it possible for stations of said group and

beam to achieve mutual synchronization; and

(vii) a schedule of outbound transmissions created by an access point in a current group period.

12. The system according to claim 1, wherein said access point broadcasts to each station of a specific beam group a Beam End Beacon that indicates termination of operation to users of that beam group, said Beam End Beacon comprising:

(i) an access point address/WLAN ID enabling identification of a transmission source for each station;

(ii) information relating to wireless network functions and protocol;

(iii) a group ID of said beam;

(iv) a beam ID of said beam; and

(v) a period in which said group is inactive, and said users can adopt an operating mode that facilitates a reduction in power consumption.

13. The system according to claim 1, wherein said access point transmits to each station of specific beam a Poll+Supervised Contention Announcement frame that defines a wireless medium polling based medium access and contention based access schedule, said Poll+Supervised Contention Announcement frame comprising:

(i) a polling list assigned to respective stations;

and

(ii) an information element that declares a medium for uplink contention based access use of a specified period known as a supervised contention access period.

14. The system according to claim 13, wherein said polling list comprises:

(i) an address of a station for which polling based access is permitted;

(ii) a polling time -that is, a time when a station can start transmission;

(iii) a polling period -that is, a period for which a station can execute transmission; and

(iv) a purpose of polling or permission for indicating to a station that polling is for a stream that requested a band beforehand, or to request reception confirmation for a downlink frame or the like transmitted in the past.

15. The system according to claim 1, wherein said access point uses an SDMA compatible antenna capable of forming a sector-shaped beam, characterized by:

(i) comparatively stable gain in a passband that minimizes fluctuation of a reception power level for a user belonging to that beam; and

(ii) sharp roll-off-that is, a narrow transition width - such that a beam is generated at short intervals

by an access point by suppressing occurrence of interference due to transmission from a particular beam to a user of a different beam, spectral efficiency is increased, and consequently high-throughput is obtained.

16. A WLAN system that uses the access point according to claim 15 that is equipped with a multi-beam antenna and is capable of generating a beam dynamically, having functions of:

(i) optimizing a reception range pattern for spatial locations of individual users and their respective traffic loads; and

(ii) minimizing traffic variance/utilization rate variance among different users of a group or beam by grouping users according to spatial location.

17. The WLAN system according to claim 16 that uses the timing structure according to claim 2, comprising:

(i) the beacon frame according to claim 5 that is transmitted periodically using an omni-directional beam pattern so as to provide reception range/detection to a new station present in an area that does not correspond to an existing antenna pattern;

(ii) a periodically repeated unsupervised access period that can be estimated by a new station from the broadcast beacon according to claim 5, for facilitating detection and association of a new station that is not

present in a reception range of an existing antenna pattern used in a supervised access period;

(iii) transmission of the Beam Start and Beam End Beacons according to claim 11 and claim 12 respectively, executed in different beams of a group period, in order to perform a service that reports a start and end of a relevant group/beam period, and reports a beam and beam group ID to each station within a reception range;

(iv) a station that is within a reception range of an existing beam that starts transmission of the association signaling according to claim 7 and claim 8 respectively, called in supervised contention access mode of a beam;

(v) a station that is not within a reception range of an existing beam that starts transmission of the association signaling according to claim 7 and claim 8 respectively during said unsupervised access;

(vi) a station that is within said reception range, to which group and beam IDs are assigned using the information elements according to claim 8;

(vii) a station that is not within said reception range, to which group and beam IDs are assigned using the frame according to claim 10; and

(viii) an access point that can perform reassignment of a new group ID to a station at any time by means of the signaling according to claim 10.

18. A medium access control method in a wireless network that has stations and an access point, said medium access control method comprising:

(i) a step of an access point transmitting an Acquisition Request frame to a station;

(ii) a step of a station responding to said Acquisition Request with a predetermined training sequence;

(iii) a step of an access point switching various beams that can be generated, and detecting a location of a user as being in a direction of a beam in which a training sequence is received at greatest strength; and

(iv) a step of updating a user location after identifying an initial location of a station.

19. The method according to claim 18, wherein a step of continuously updating a location of a user by said access point comprises:

(i) a step of using a primary beam that is static and has the characteristics according to claim 15, used to receive a transmission from a station;

(ii) a step of using a controllable secondary beam having the characteristics according to claim 15 that sweeps a vicinity of said primary beam;

(iii) a step of identifying an angular location of a secondary beam for which a transient phenomenon exists in a reception power level; and

(iv) a step of giving a location of a station by bisecting an angle whose range is determined by said two beam locations.

20. A WLAN system using the access point equipped with a multi-beam antenna according to claim 15, being able to cover all space with one set of fixed beams so that overlapping between adjacent beams is minimized, and having at least two group IDs.

21. The WLAN system according to claim 20, wherein:

(i) an access point transmits the Beam Start Beacon and Beam End Beacon according to claim 11 and claim 12 respectively are transmitted respectively in beams of different group periods in order to perform a service that reports a start and end of a relevant group/beam period, and reports a beam and beam group ID to each station within a reception range;

(ii) a station detects a group/beam ID of an area in which there is a station indicated to an access point by means of the association signaling according to claim 7 and claim 8 respectively, called in supervised contention access mode of a group/beam;

(iii) an access point responds to said association signaling and assigns a group/beam ID to a station, and also, in the case of a station present in an overlap area between beams of two groups, optimizes traffic variance

of users of different beams within a group; and

(iv) an access point can perform reassignment of a new group ID to a station at any time using the signaling according to claim 10.

22. A medium access control method in a wireless network that has stations and an access point, said medium access control method comprising:

(i) a step of an access point detecting station movement by observing consecutive polling failures or a confirmation response from a station;

(ii) a step of an access point transmitting a new Group—ID Assign to a station that has been lost track of using a beam adjacent to an original beam;

(iii) a step of an access point retransmitting the Acquisition Request signaling according to claim 18 if station reacquisition is not possible by means of said step (ii); and

(iv)a step of a station, in case of detecting occurrence with high probability of polling failure or failure of a confirmation response from an access point and/or loss of a Beam Start or Beam End Beacon of an assigned group, discontinuing all power-saving operations, and an access point performing reacquisition of that station using said steps (ii) and (iii).

23. A medium access control method in a wireless network

that has stations and an access point, said medium access control method being period division by group of a supervised access period, performed in order to facilitate power-saving operation of stations of a specific group until a next operation period, and comprising:

(i) a step of reporting a start and end of a group operation period to users of said group using the Beam Start and Beam End Beacons according to claim 11 and claim 12 respectively; and

(ii) a step of performing synchronization of Beam Start and Beam End Beacon transmission for all beams of a specific group.

24. The system according to claim 11, wherein a downlink schedule element of said Beam Start Beacon:

(i) shows an outbound transmission schedule composed of a transmission destination address, transmission length, and time at which said transmission is performed; and

(ii) shows an end of an outbound transmission schedule-that is, a transmission time corresponding to a Poll+Supervised Contention Announcement frame-and enables a station that is not scheduled to receive an outbound transmission in a given group period to execute power-saving in a downlink period of that group period.

25. A medium access control method in a wireless network that has stations and an access point, wherein, in order to avoid a collision with another beam due to imperfect separation of actual RF components and a collision in an access point itself, transmissions by means of different beams in a same group are aggregated and synchronized in:

(i) a downlink phase composed of all outbound transmissions corresponding to the downlink schedule element according to claim 24, with stations of said group as objects; and

(ii) an uplink phase composed of transmissions performed from stations to an access point using both polling based access and contention based access mechanisms according to claim 4.

26. The method according to claim 25, wherein said downlink phase aggregates all outbound transmissions, suppresses unnecessary overhead, and improves medium utilization, by employing the steps of:

(i) using a common preamble transmitted by an access point for Beam Start Beacon use that enables all receivers to synchronize; and

(ii) eliminating a frame interval between outbound frames.

27. The method according to claim 25, wherein, in order

to minimize overhead due to individual polls and render unnecessary resynchronization for transmission of individual polls, said uplink phase comprises:

(i) a polling access phase in which each station transmits over a permission/polling period included in a Poll + Supervised Contention Announcement frame schedule; and

(ii) a supervised contention phase permitted until scheduled transmission of a Beam End Beacon following a polling access phase.

28. The method according to claim 27, wherein a guard time is used that is a time between consecutive polling transmissions included in said schedule, after handling of a local clock drift phenomenon of each station, provided in a period in which a medium is vacant longer than an RIFS and shorter than a CIFS.

29. A medium access control method in a wireless network that has stations and an access point, wherein, in order to minimize collisions due to a rogue station that uses carrier sensing not in accordance with a protocol of a WLAN system, said medium access control method comprises:

(i) a step of transmitting dummy or pad data and equalizing transmission times in all beams, preventing a station that uses a rogue carrier sensing method from detecting a vacant medium, and as a result avoiding

transmission from a rogue station, thereby eliminating variance of outbound transmission times by different beams of a given group; and

(ii) a step of each station polled with the object of a confirmation response in an uplink phase transmitting a confirmation response frame indicating a negative response-that is, each station ignoring a confirmation response request-thereby not permitting a gap exceeding a CIFS period in a transmission structure.

30. A medium access control method in a wireless network that has stations and an access point, wherein, in order to detect and handle existence of a rogue station in a wireless network, said medium access control method comprises:

(i) a step of detecting that there is a rogue station if observing that transmission ended in failure in all beams at a same time; and

(ii) a step of, in case of detection of existence of said rogue station, switching to unsupervised access mode and directing that rogue station to transfer to another channel.

31. A medium access control method in a wireless network that has stations and an access point, wherein, in order for an access point to execute stream permission for a resource reservation request, said medium access control

method comprises:

(i) a step of analyzing a transmission source address and transmission destination address of a stream, and determining whether or not both addresses exist in a same wireless network; and

(ii) a step of requesting an access point to assure resource use in one group/beam or other before accepting a request.

32. A medium access control method in a wireless network that has stations and an access point, wherein, in order for an access point and each terminal to execute power control and limit channel interference with respect to other users, thereby leading to a reduction in transmission power, and consequently to battery savings, said medium access control method comprises:

(i) a step of embedding a transmission power level used in transmission of a specific frame/packet in a transmit signal;

(ii) a step of measuring reception power corresponding to specific packet transmission in a receiver; and

(iii) a step of comparing a value obtained by decoding information coded in said transmission with said measurement result, and adjusting transmission power of a next packet sent by a transmitter of said packet accordingly.